

**Electrochemical Study of the Formation of Passive Layers on Lead-base Alloys Immersed in an Aqueous Solution with High Sulphate Contents**

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The process for the anodic formation of PbSO<sub>4</sub> films over a lead electrode and two tin-containing lead-alloys electrodes, namely, high and low-tin contents. Anodic film formation was electrochemically studied in a 5.31 M sulfuric acid aqueous solution. For all cases, it was found, from the potential step technique, that the same mechanism of formation for the lead sulfate anodic film<sup>1</sup> governs the process, and that it takes place through three different contributions to the total current (J(t)), as is indicated in equation (1)

$$J(t) = J_g(t) + J_d(t) + J_f(t) \quad (1)$$

Where **J<sub>g</sub>** corresponds to the current density contribution due to 2D nucleation and growth of the insoluble PbSO<sub>4</sub>, **J<sub>d</sub>** is the current density involved during electrodisolution of the lead electrode in the zones which are not covered yet by the lead sulfate film and **J<sub>f</sub>** is the contribution due to the growth of the passive layer induced by electrodisolution of lead metal and transport of the resulting Pb(II) ions through the surface film. However, the contribution of each stage to the overall process was different, depending upon the ratio Pb:Sn.

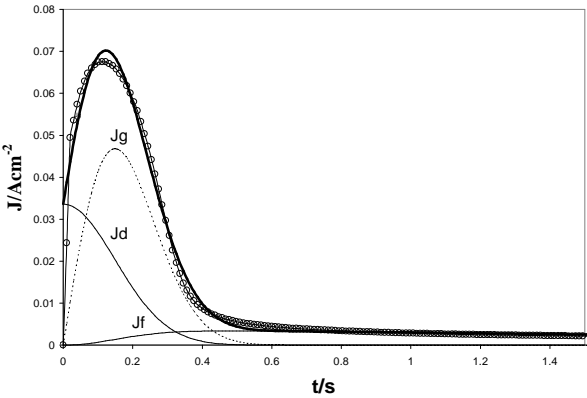
The results from voltammetry indicate that it is possible to establish the potential at which the lead sulfate film begins to form and that this was a function of the ratio above (see Figure 2). From Figure 2 it can be observed that the oxidation potential is most positive for the low tin-containing alloy electrode. For all cases, the applied potential needed to form the passive layer influences the relative importance of each contribution to the overall process.

**Acknowledgements**

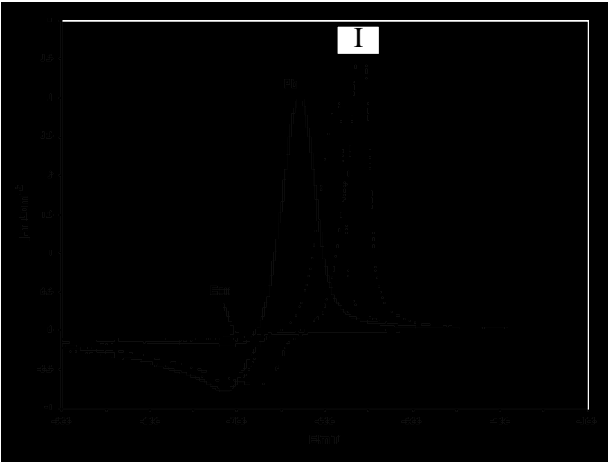
This work was financed by DEPI-IP.N., CONACYT (Projects 32158E and 31261-U) and by the UAM-A DCBI (Project 2260220). E.A., JMH y M.P.P. are indebted to SNI for the fellowship.

**References**

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**Figure 1.** Fitting (—) of an experimental current transient (OOO) obtained during the oxidation of a lead-alloy electrode containing high-tin, in 5.31 M sulfuric acid aqueous solution, according to equation (1). The individual contributions to the total current are also shown.



**Figure 2.** Typical voltammetric curves obtained in the systems: (Pb) Pb/5.31 M H<sub>2</sub>SO<sub>4</sub> (aq), (I) Pb-low Sn and (II) Pb-high Sn/5.31 M H<sub>2</sub>SO<sub>4</sub> (aq). In all cases the potential scan initiated at –900mV vs SCE in the positive direction. The scan potential rate was 20 mVs<sup>-1</sup>.